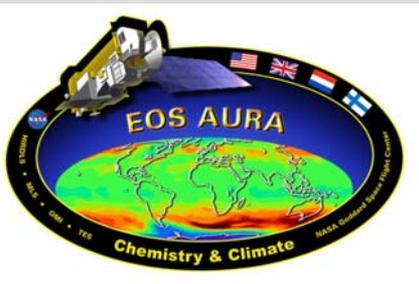


# Validation Results of the OMI Calibration and Validation Announcement of Opportunity

**Mark Kroon – KNMI**  
**On behalf of ALL the OMI AO PI's**

**Aura Science Team Meeting**  
**14 August 2006**



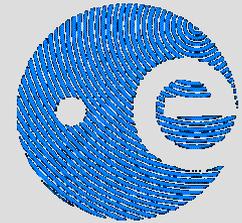
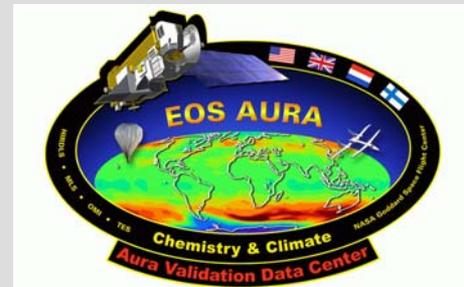
# Chronology

- External OMI project review early 2003
- Recommends AO for calibration & validation
- Call opened 24 May / closed 24 September 2004
- Synchronized with Aura validation NRA
- 21 proposal received / accepted



# Partners

- NIVR – funding OMI project
- ESA – logistics support
- KNMI – housing OMI project
- AVDC – OMI data distribution



# Framework

- No funding involved from OMI side
- National funding only, letters of support
- OMI data access following proof of funding
- OMI data distribution by AVDC (protocol)



# ESA KNMI NIVR AO

- First ESA AO on Non-ESA instrument
- ESA provided website logistics
- 21 proposals (20 Europe + 1 US)
- Recognized European scientists
- Strong participation former East block
- International review (11 KNMI, 22 US)
- All proposals accepted!
- AVDC Access after Proof of Funding

## People Involved

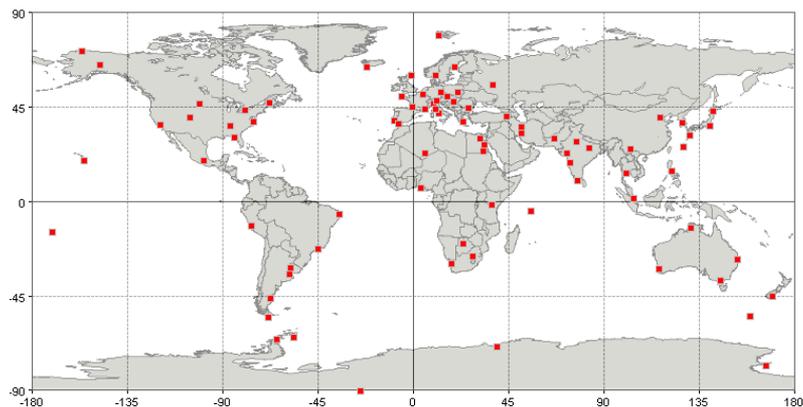
Claus Zehner, Yves Louis Desnos, Rita Malosti, Francesco Pallazo, Mark Kroon, Ellen Brinksma, Pieter Levelt, Ernie Hilsenrath, Gilbert Leppelmeier, Joost Carpay, Bojan Bojkov, Mike Kurylo

The screenshot shows the ESA Earth Observation Principal Investigator Portal. The header includes the ESA logo and the text 'Earth Observation Principal Investigator Portal'. The main content area is divided into several sections: '05-Jul-2004 UT', 'Principal Investigator', 'Evaluator', 'Correspondent', and 'Contact us'. There are navigation tabs for 'Exploitation Results & News', 'Results', 'News', 'Search', 'Focus on PI', 'Round table', 'AO Submission', 'Cat-1 & Open AOs', 'Previous AOs', 'Update & Reporting', 'Services', 'About this site', 'ESA Data Policy', 'FAQ', 'Related Links', and 'How to get ESA data'. The 'Results' section features several articles with images, including 'InSAR to detect Silent Earthquakes', 'The 2003 Bam (Iran) earthquake: Rupture of a blind strike-slip fault', 'Operational SAR Interferometry at Active Volcanoes', 'Inter-annual variations of Arctic multi-year sea ice, 1991-2001', 'The shape of the globe detected by space', and 'The tropical and subtropical ocean viewed by ERS SAR'. The 'Focus on PI' section highlights 'Prof. Dr. David Sandwell', 'ESA NRSCC Dragon Cooperation Programme', and 'ENVISAT Symposium: Outline Program released'. The 'Search' section includes a 'Main search' button. The 'Update / Report' section has a login form with fields for 'login' and 'password', and a 'GO' button. The 'Open AOs' section lists 'Category-1', 'Tiger AO', 'Cat-1 OMI CalVal', and 'EPS/MetOp RAO'. The footer includes the text '@ Copyright ESA'.

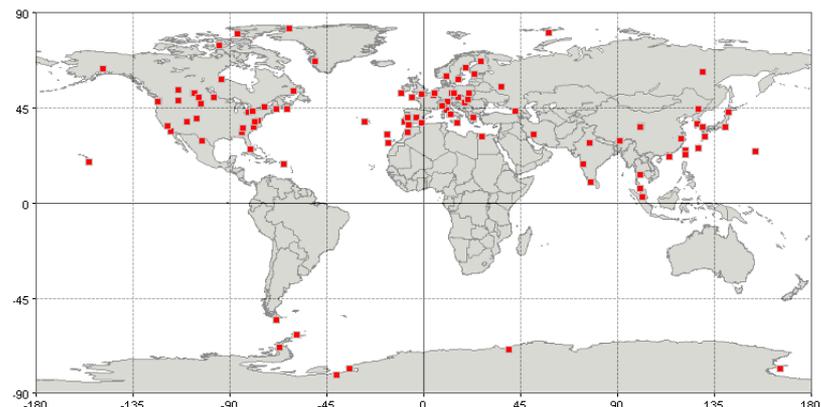
The screenshot shows the OMI Call for Proposals page on the ESA Earth Observation Principal Investigator Portal. The header includes the ESA logo and the text 'Earth Observation Principal Investigator Portal'. The main content area is divided into several sections: '05-Jul-2004 UT', 'Exploitation Results & News', 'OMI Call for Proposals', and 'Contact us'. There are navigation tabs for 'Results', 'News', 'Search', 'Focus on PI', 'Round table', 'AO Submission', 'Cat-1 & Open AOs', 'Previous AOs', 'Update & Reporting', 'Services', 'About this site', 'ESA Data Policy', 'FAQ', 'Related Links', and 'How to get ESA data'. The 'OMI Call for Proposals' section features a welcome message: 'Welcome to the submission area for OMI data Calibration and Validation call for proposals.' Below this, it states: 'The deadline for the submission of OMI data Calibration and Validation proposals is September 24th 2004.' There are several links provided: 'OMI data Calibration and Validation call for proposals - Main text', 'Terms and Conditions for the access and utilization of OMI data', 'Terms and Conditions for the use of ESA data', and 'Guidelines for the submission of proposals for the OMI data Calibration and Validation call'. The 'Update & Reporting' section has links for 'Submit a new Proposal' and 'Modify a Proposal'. The 'Services' section states: 'The OMI data Calibration and Validation call for proposals is a joint effort between the Netherlands Agency for Aerospace Programs NIVR, the Royal Netherlands Meteorological Institute KNMI and the European Space Agency ESA.' The 'About this site' section includes the text: 'Should you need more information about the OMI data Calibration and Validation call for proposals, you can contact ESA, KNMI or NIVR. Information on the instrument can be found on the OMI Website and on the AURA Website. Reference documentation on OMI calibration, OMI algorithms and OMI validation can be found on the dedicated OMI website at KNMI (on the link "scientists" and then "documents").' The footer includes the text '@ Copyright ESA'. The OMI logo is visible on the right side of the page.

# Ozone – Ground Based Validation

WOUDC Data in Archive Map View of Platforms

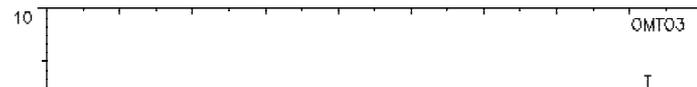
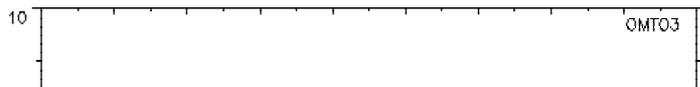


WOUDC Data in Archive Map View of Platforms



**2925 - Validation of OMI total ozone using ground-based Brewer observations. Dr. Dimitris Balis, Aristotle University of Thessaloniki - Laboratory of Atmospheric Physics, Greece**

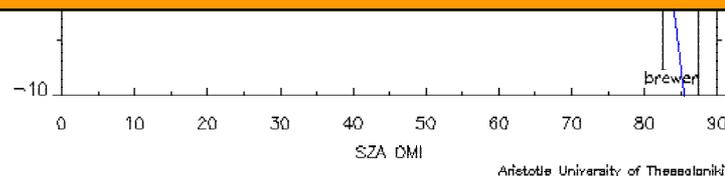
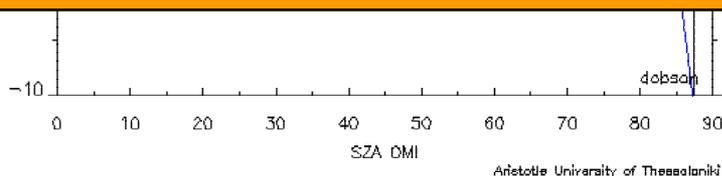
# Ozone – Ground Based Validation



The average difference between OMI-DOAS and Brewer observations is 1.03% while the corresponding difference between OMI-TOMS and Brewer observations is -0.12% (valid mainly for 30° N - 60° N).

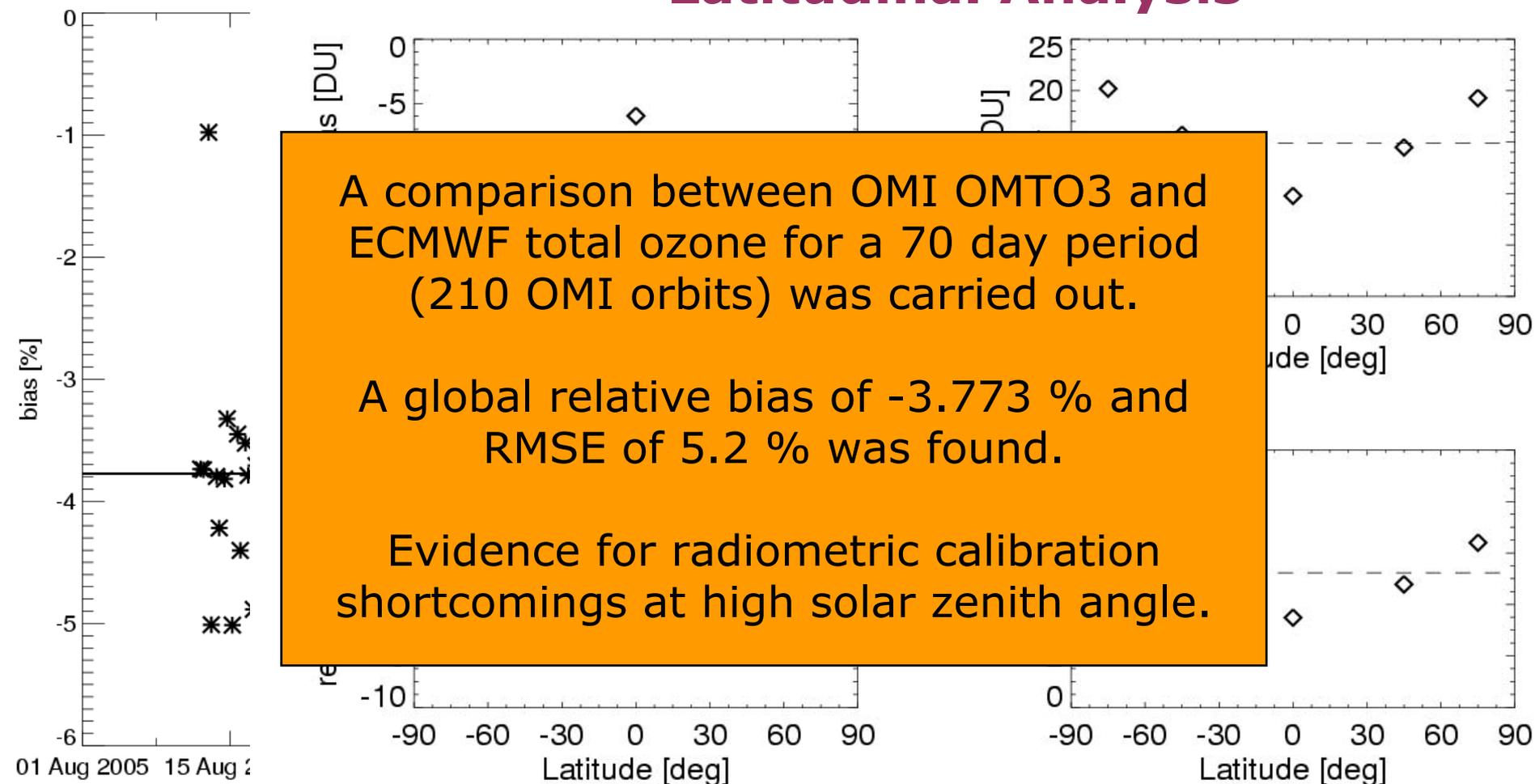
The average difference between OMI-DOAS and Dobson observations is about 2.7%, showing however better agreement over 30° S - 40° S. The average difference between OMI-TOMS and Dobson observations is about 1%, with higher values for the tropics.

The OMI-DOAS comparisons reveal a dependence on SZA.



# Ozone – Model Comparison

## Latitudinal Analysis



# NO<sub>2</sub> – Ground Based Validation

## Systeme d'Analyse par Observations Zenithales (SAOZ)

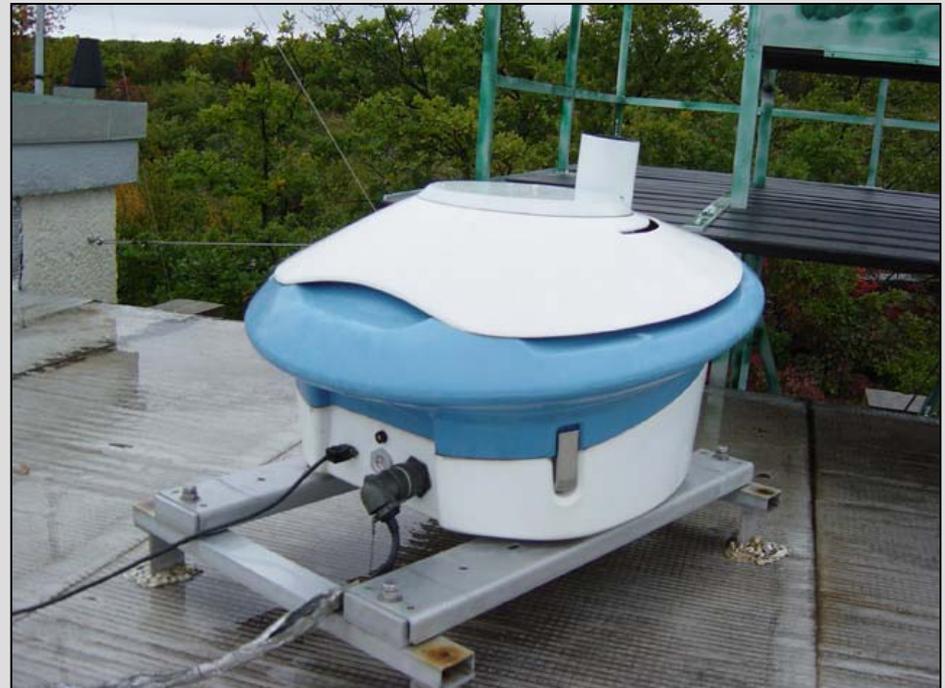
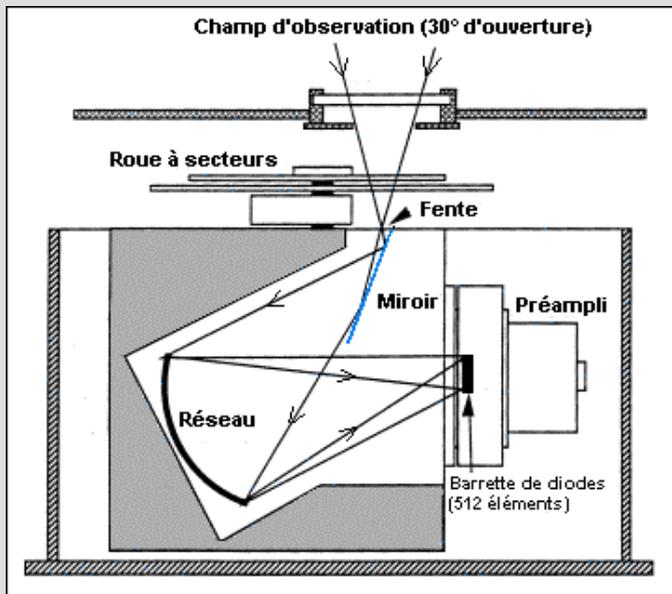
Zenith sky measurements at twilight ( $86^\circ < \text{SZA} < 91^\circ$ )

Differential Optical Absorption Spectroscopy (DOAS)

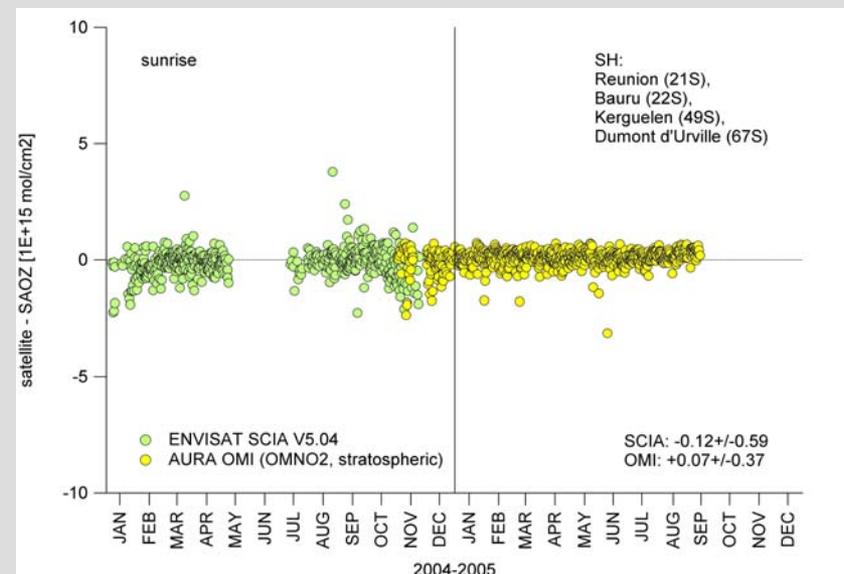
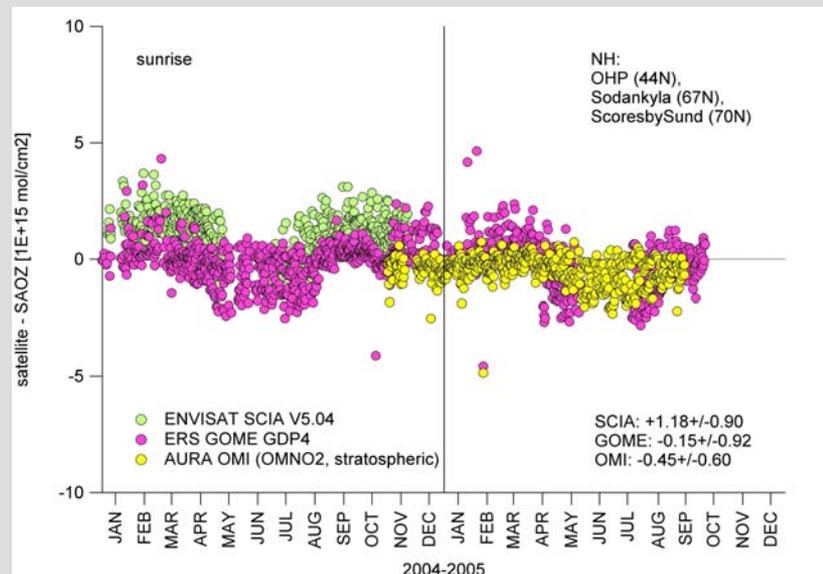
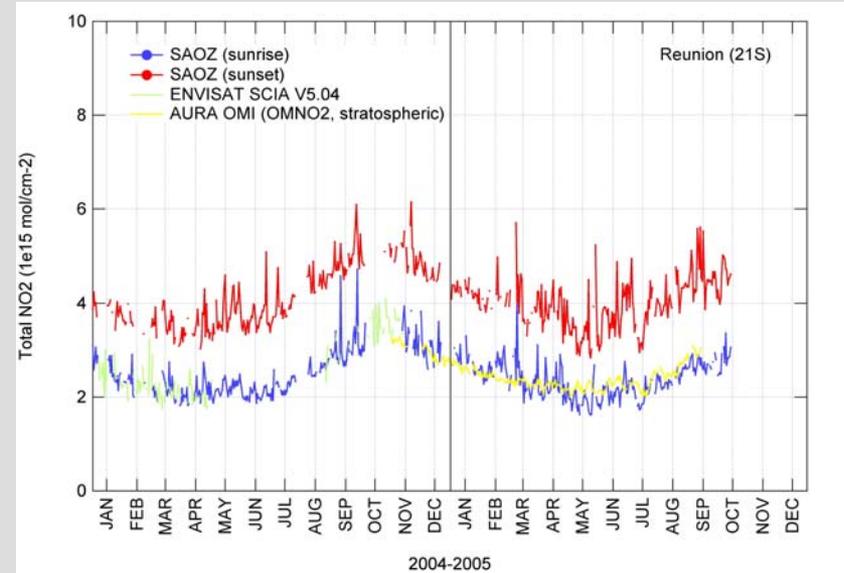
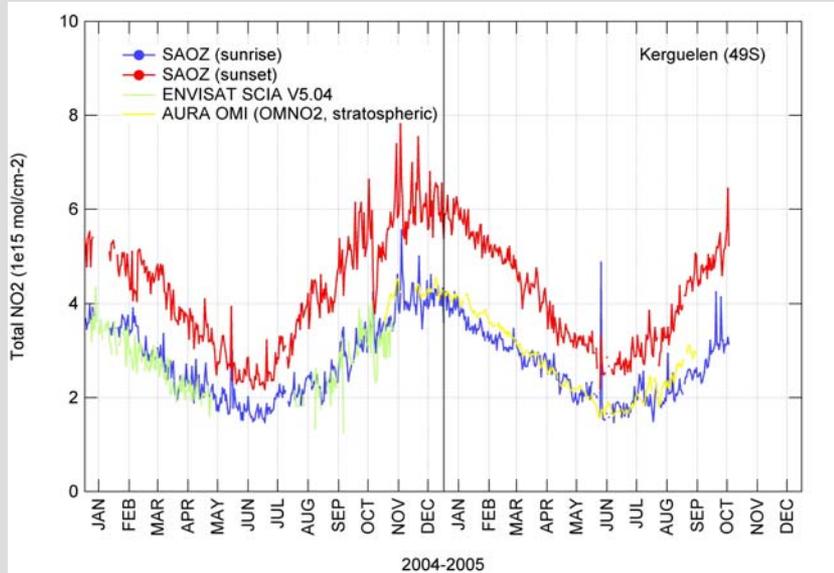
Ozone: 450-590 nm Chappuis Band, temperature independent

NO<sub>2</sub>: 400-550 nm

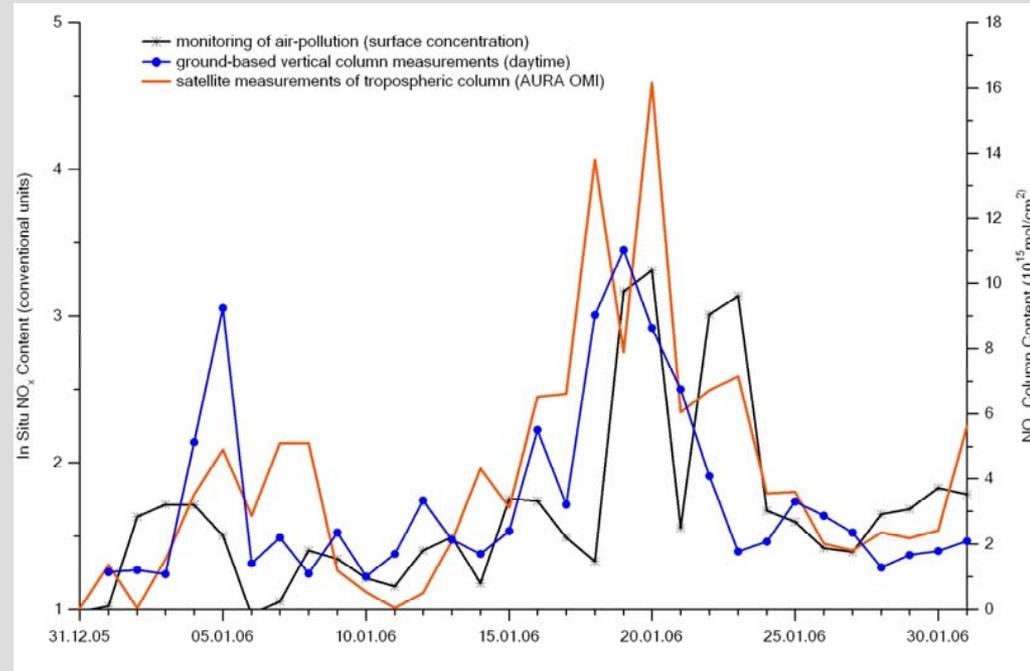
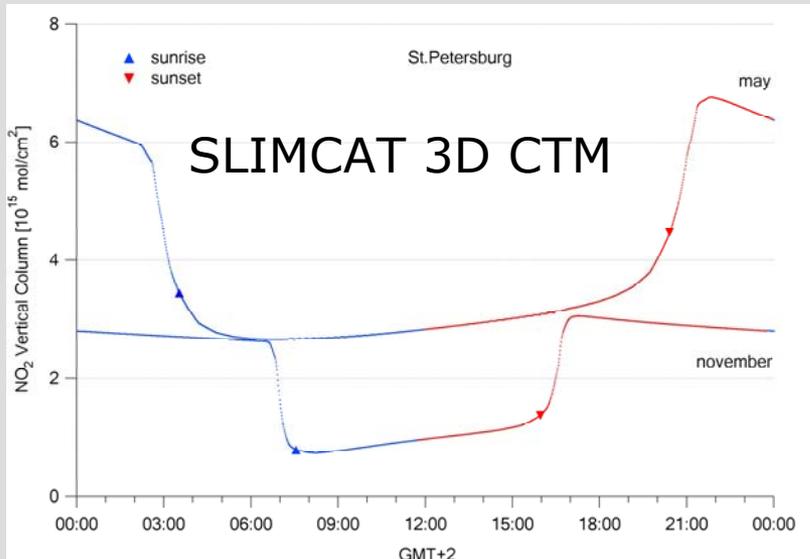
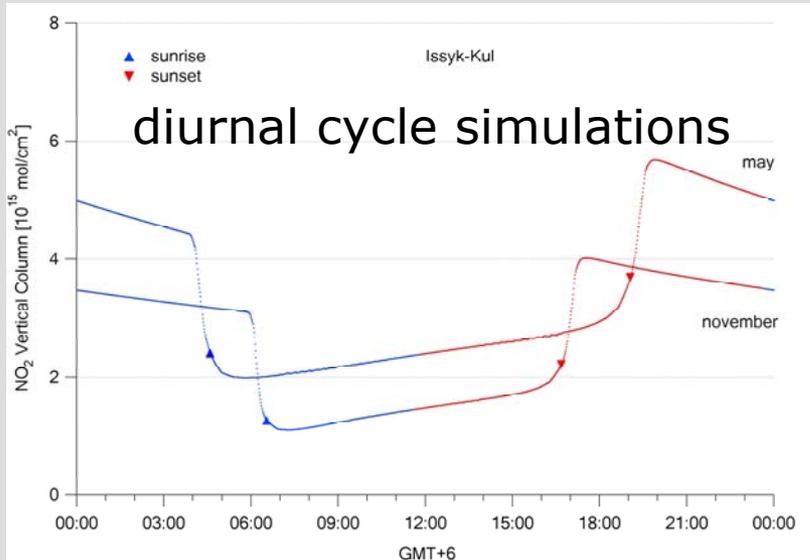
NDSC qualified



# NO2 - Ground Based Validation



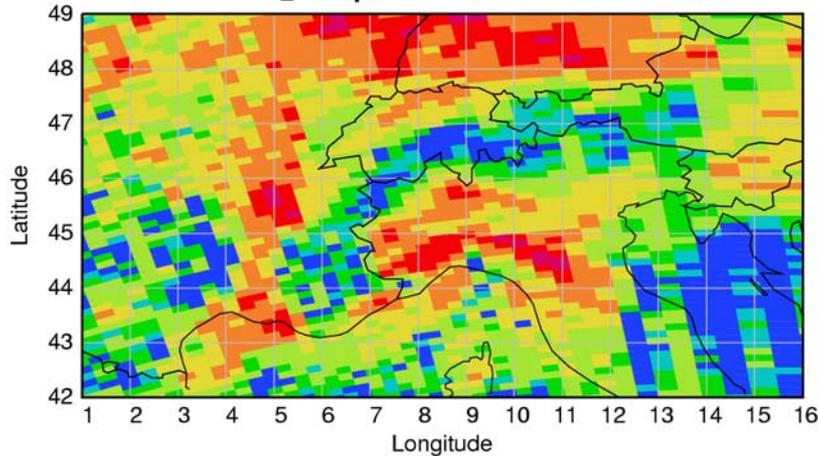
# NO<sub>2</sub> – Modeling and Measuring



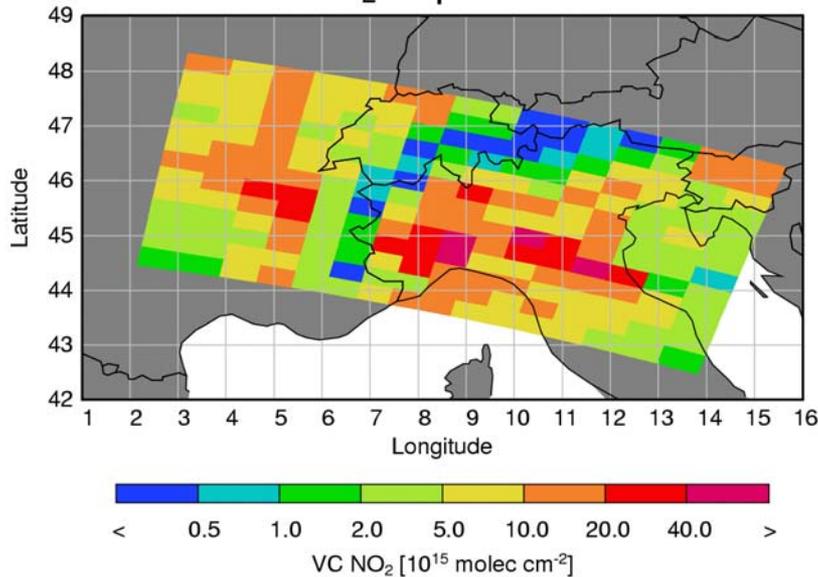
Comparison of ground-based column NO<sub>2</sub> observations at St. Petersburg with in situ NO<sub>x</sub> measurements and provisional AURA OMI tropospheric NO<sub>2</sub> in January 2006

# NO<sub>2</sub> – Retrievals and Observations

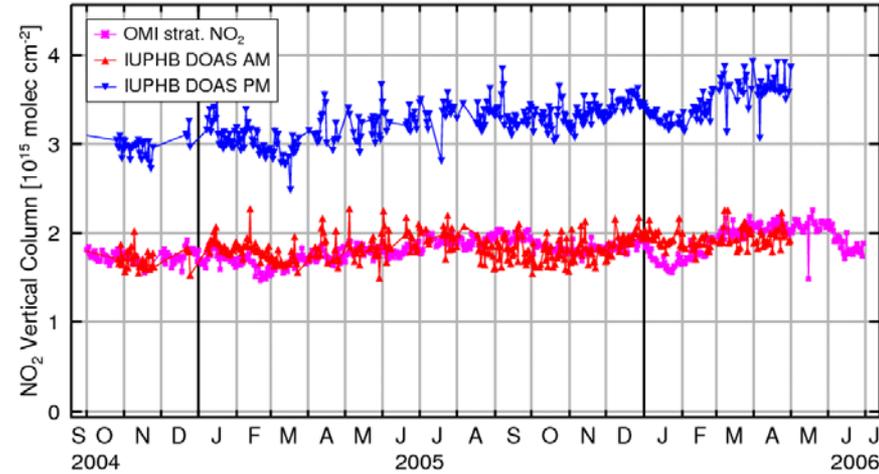
OMI NO<sub>2</sub> trop. Bremen 2005/03/01



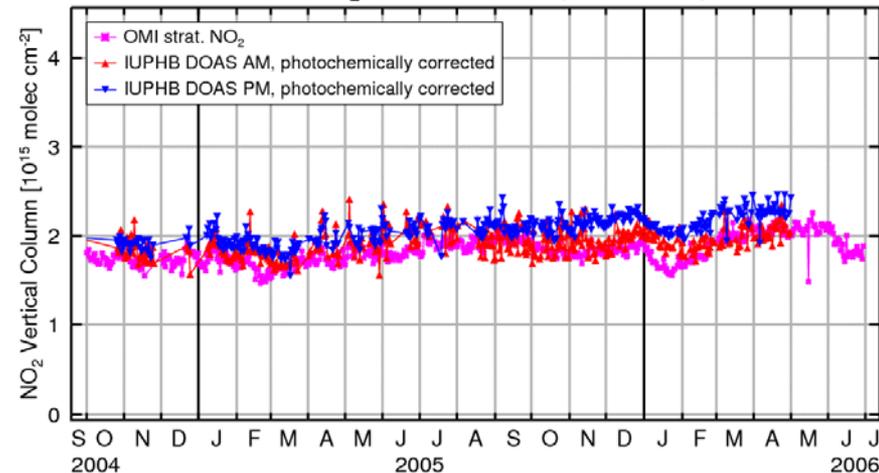
SCIAMACHY NO<sub>2</sub> trop. Bremen 2005/03/01



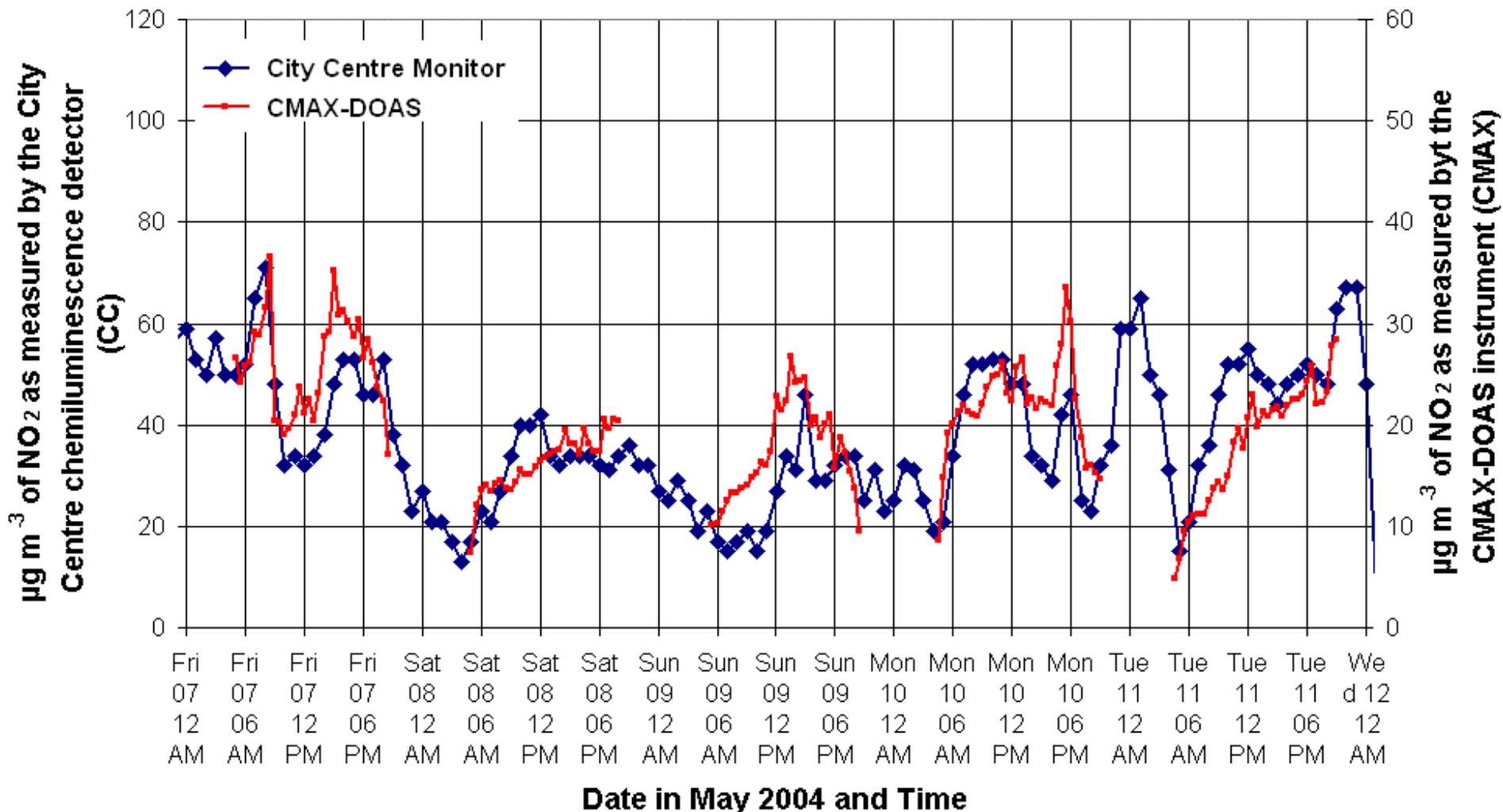
OMI NO<sub>2</sub> above Merida (8°N, 71°W)



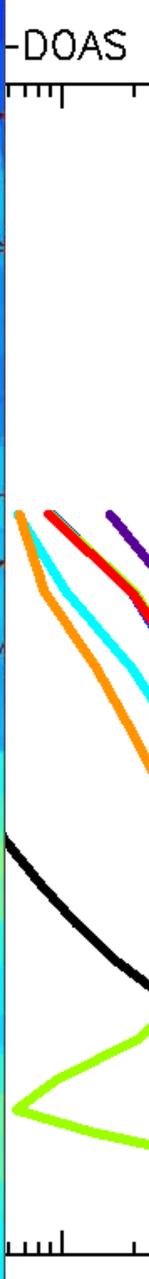
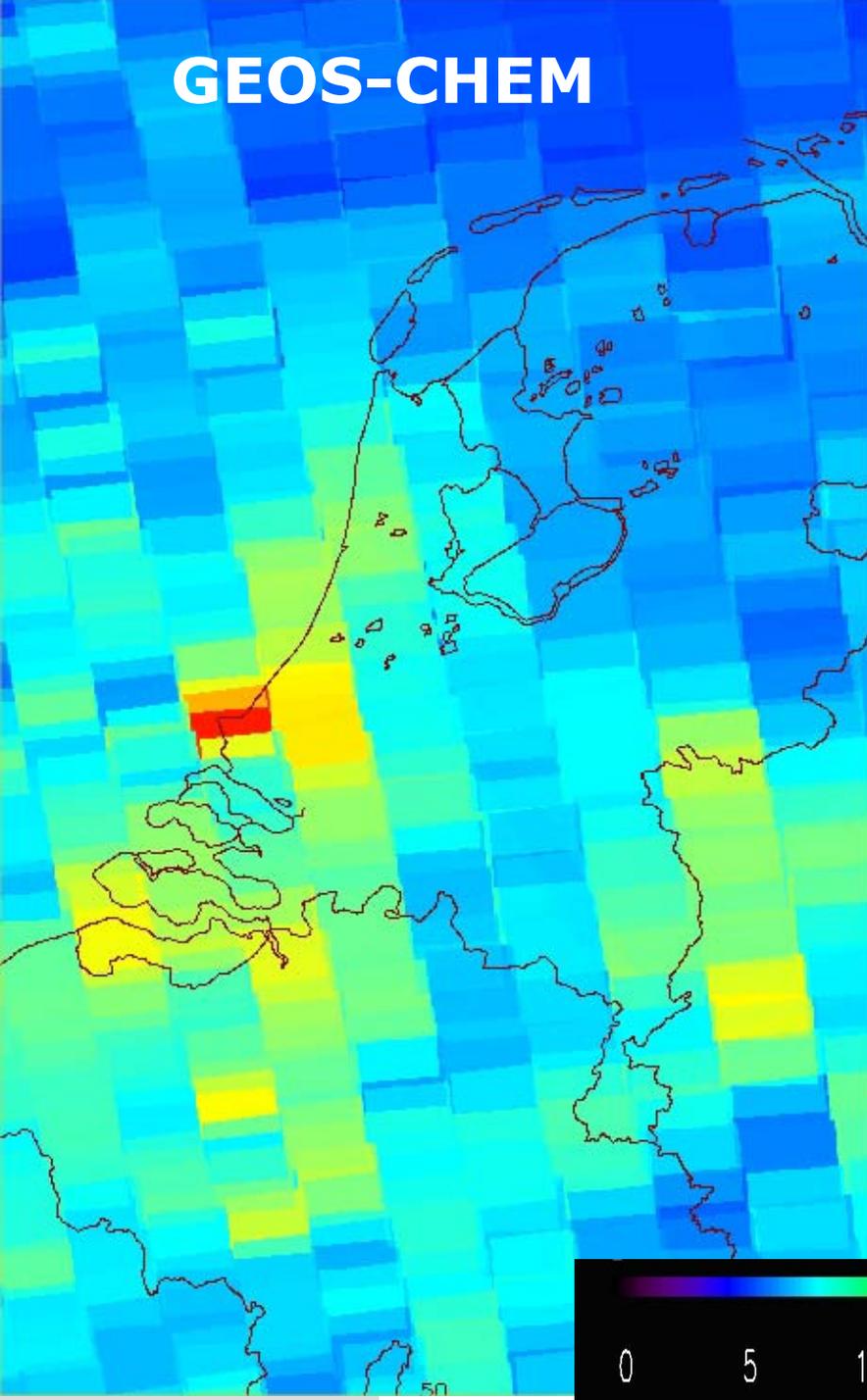
OMI NO<sub>2</sub> above Merida (8°N, 71°W)



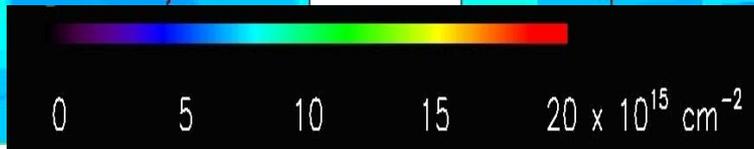
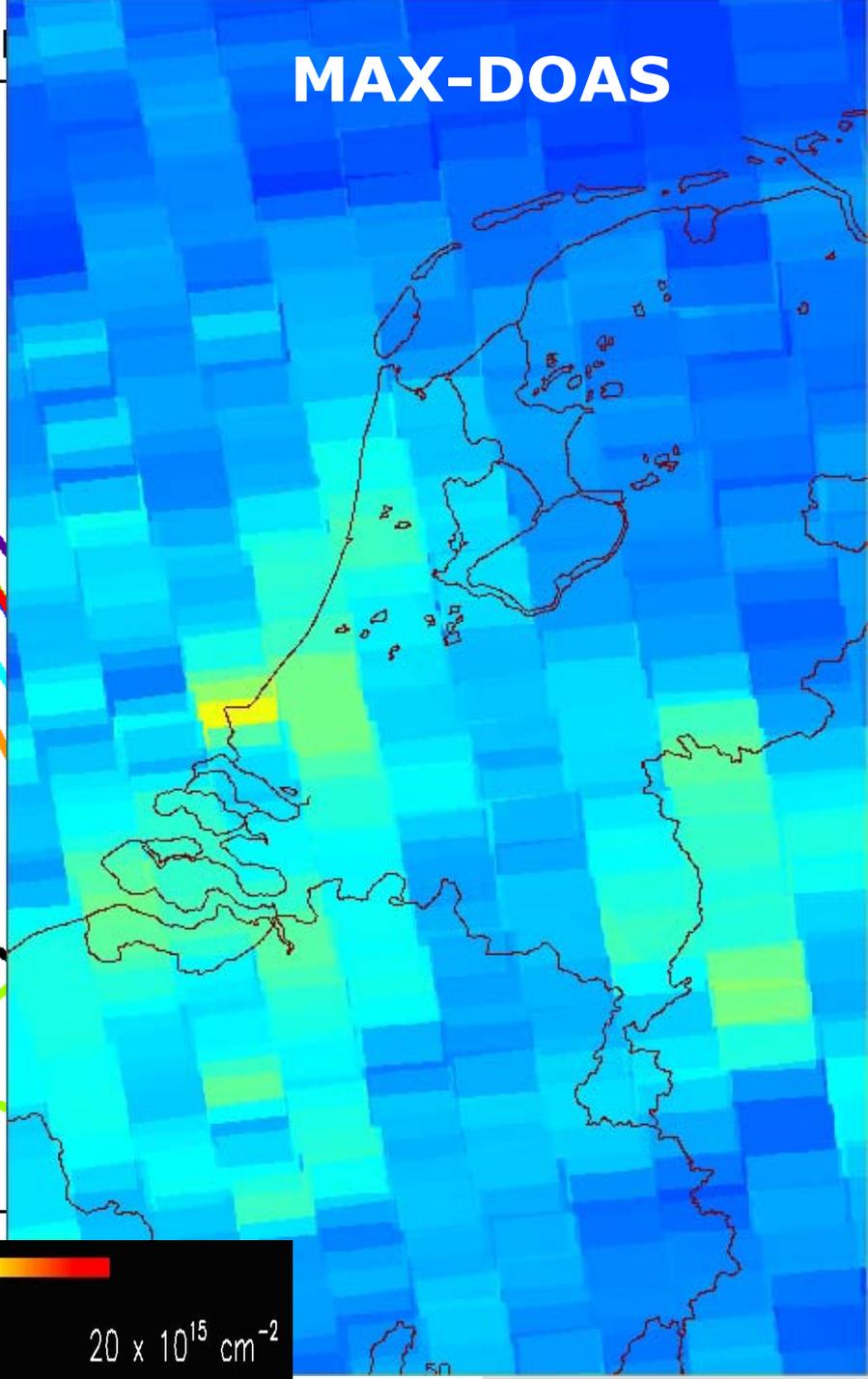
# NO<sub>2</sub> – System Development

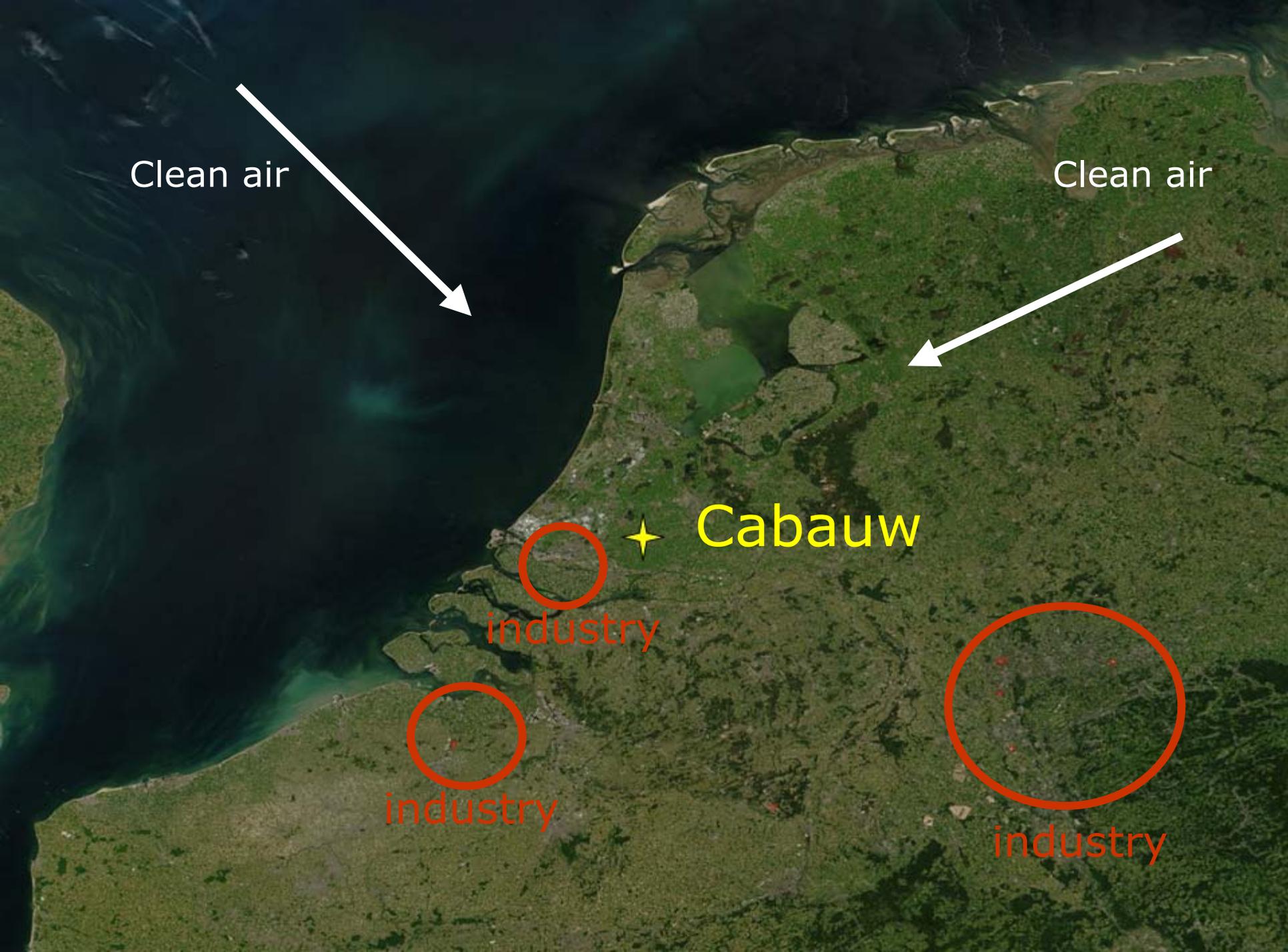


**GEOS-CHEM**



**MAX-DOAS**





Clean air

Clean air

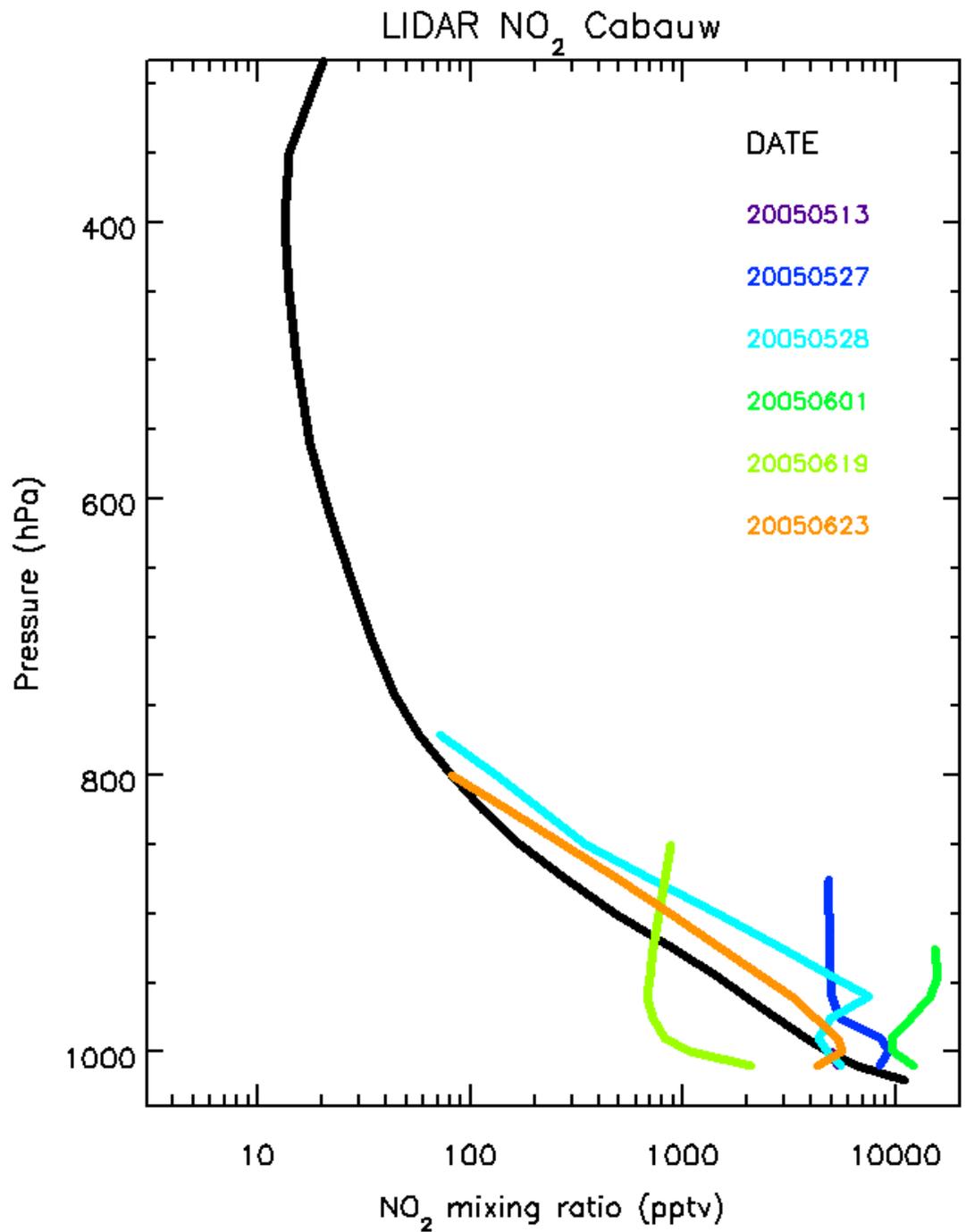
Cabauw

industry

industry

industry

# NO<sub>2</sub> - M

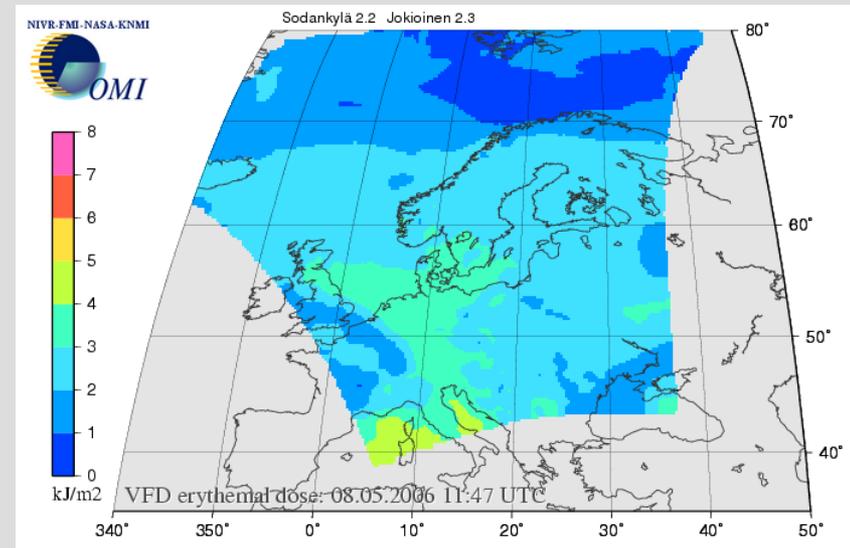
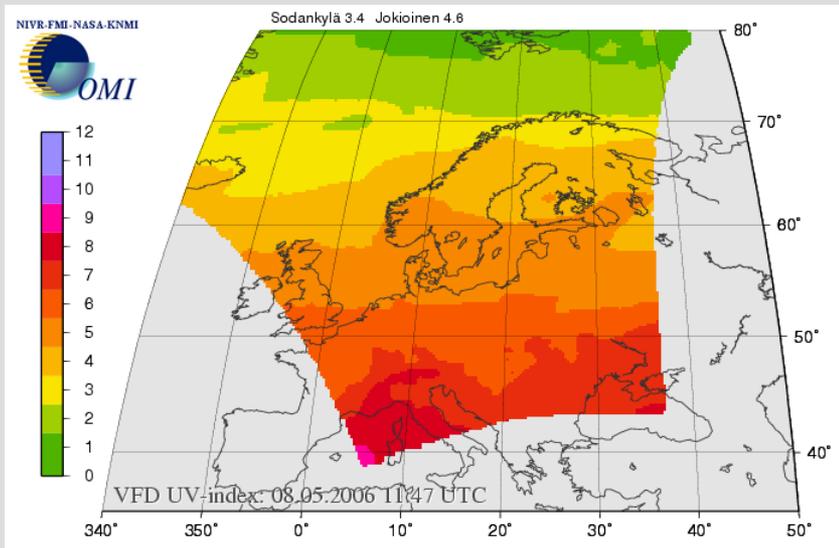
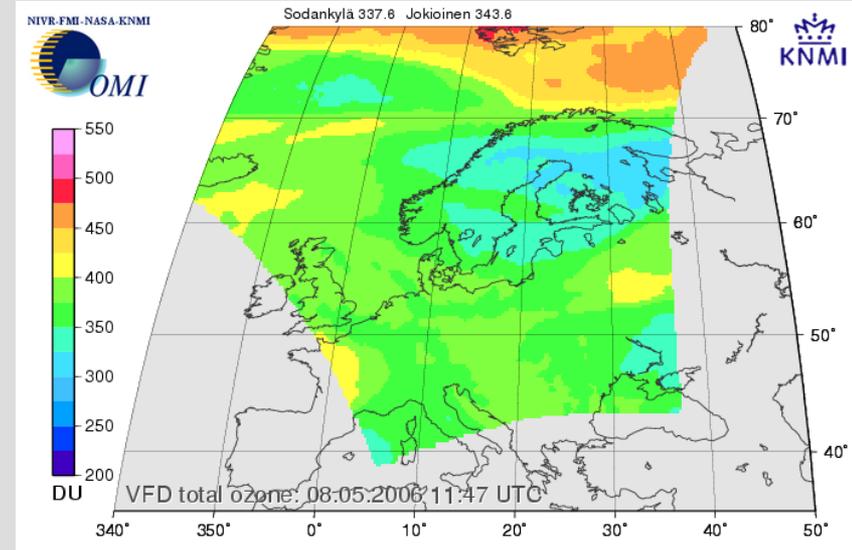


# Surface-UV – Very fast Delivery

## OMI Very-Fast-Delivery has been operational since March 2006

OMI data is received by Direct Broadcast in Sodankylä and is processed immediately after each overpass of the Aura satellite. Distribution plots for total column ozone, UV Index and Erythemal daily dose are published within 30 minutes after the overpass at

[http://omivfd.fmi.fi/index\\_eng.html](http://omivfd.fmi.fi/index_eng.html)

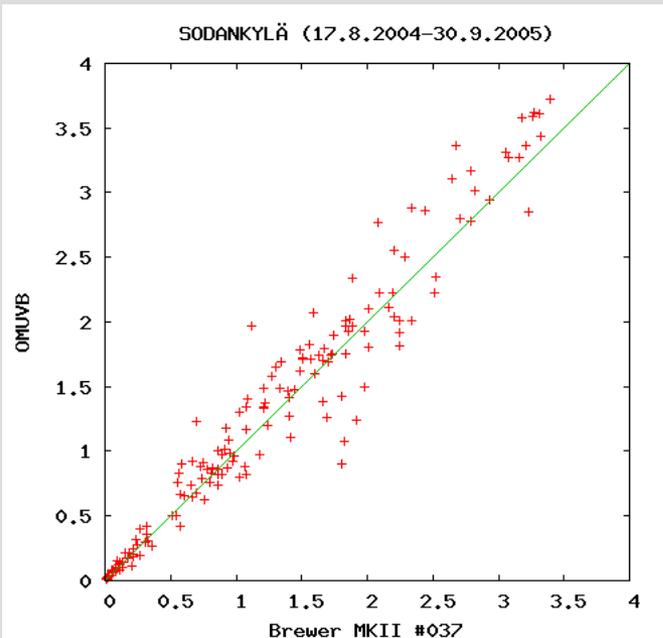


# Surface-UV – Ground Based Validation

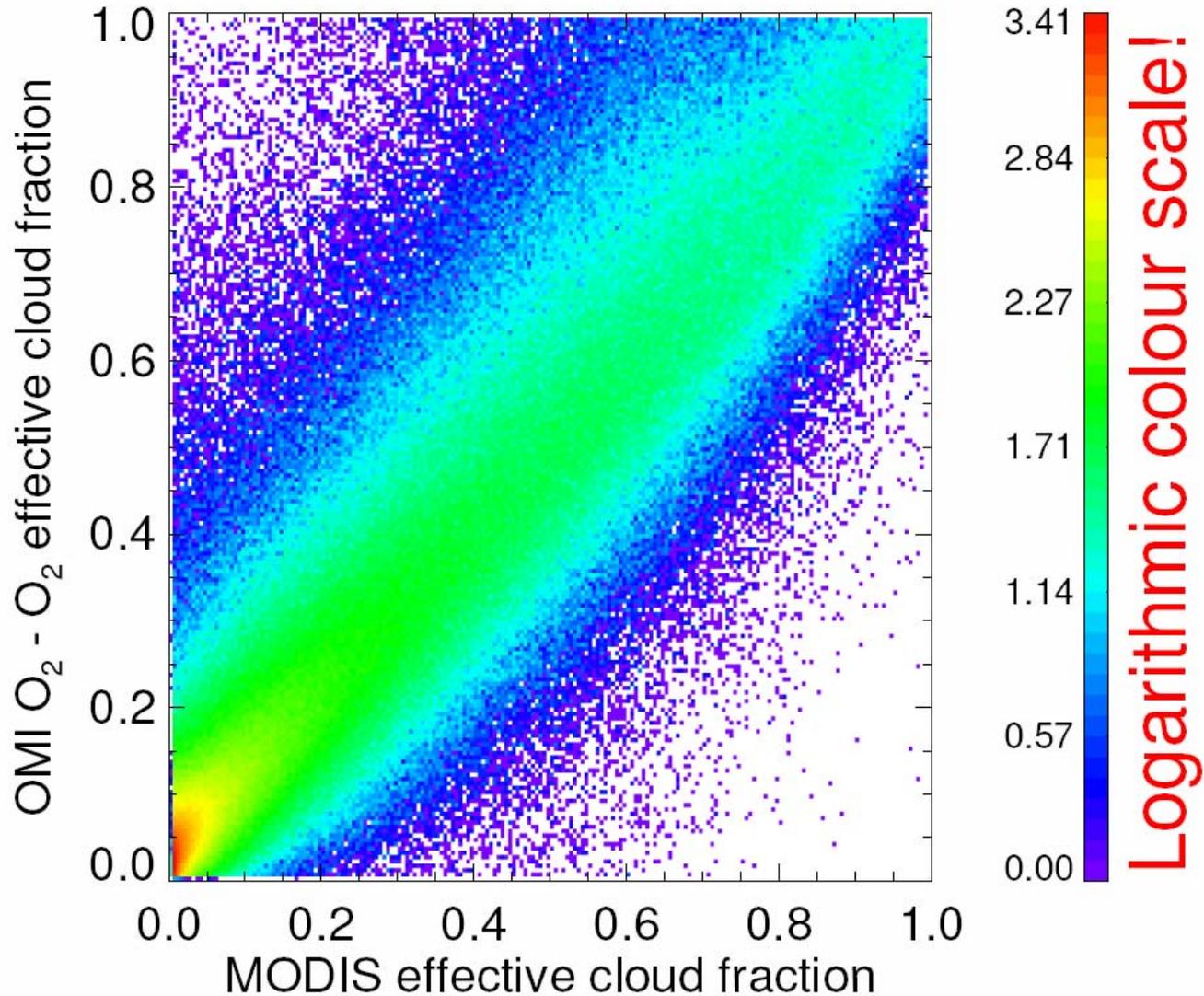


Validation Statistics for Daily Doses [kJ/m<sup>2</sup>]

<b>Validation instrument</b>	<b>n</b>	<b>%Bias</b>	<b>%RMS</b>	<b>r</b>
Jokioinen Brewer Mk-III #107	421	3.6%	33%	0.99
Sodankylä Brewer Mk-II #037	175	7.6%	22%	0.97
Toronto Brewer Mk-II #014	262	-3.7%	24%	0.98
Toronto Brewer Mk-III #145	232	-9.4%	25%	0.97
San Diego SUV-100	293	31%	41%	0.95
Ushuaia SUV-100	339	2.6%	25%	0.97
Barrow SUV-100	203	19%	36%	0.94
Palmer	438	7.3%	24%	0.97
Tokyo	251	58%	75%	0.92



# Results - Clouds



# Results – Systems and Networks

## Systems

Mini MAX-DOAS (many including KNMI)  
MF-DOAS (Leicester)  
MAX-DOAS (Bremen, Heidelberg, Brussels)  
NO2 Lidar (RIVM)



## Networks

BREDOM MAX-DOAS (IUP-Bremen, IUP-Heidelberg)  
AERONET  
FTIR  
SAOZ  
Surface-UV  
Brewer  
Dobson  
Umkehr  
Sondes



## Satellite Instruments

SCIAMACHY (O3, NO2, OCIO, HCHO, BrO, CHO-CHO, Aerosols)

# Results – People – OMI AO PI's

Dr. Dimitris Balis	LAP	Greece
Dr. Philippe Demoulin	IAG	Belgium
Dr. Fabio Del Frate	TVU	Italy
Dr. Aleksandr N. Gruzdev	IAP	Russian Federation
Dr. Ernest Hilsenrath	GSFC	USA
Prof. Dr. Janusz Krzyscin	IGFPAS	Poland
Dr. Jean-Christopher Lambert	BIRA	Belgium
Dr. Rene Lemoine	KMI	Belgium
Dr. Pieternel F. Levelt	KNMI	Netherlands
Dr. Stefano Migliorini	NERC	United Kingdom
Dr. Paul Monks	LU	United Kingdom
Prof. Dr. Justus Notholt	IUP	Germany
Dr. Andreas Richter	IPU	Germany
Dr. Vincenzo Rizi	CETEMPS	Italy
Dr. Angelina Shavrina	MAO	Ukraine
Dr. Pieter Stammes	KNMI	Netherlands
Dr. Aapo Tanskanen	FMI	Finland
Prof. Dr. Yury Timofeyev	SPB	Russian Federation
Dr. Thomas Wagner	IUP	Germany
Dr. Mark Weber	IUP	Germany
Prof. Dr. Philipp Weihs	BOKU	Switzerland

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Dr. Andreas Richter	IPU	Germany
Dr. Vincenzo Rizi	CETEMPS	Italy
Dr. Angelina Shavrina	MAO	Ukraine
Dr. Pieter Stammes	KNMI	Netherlands
Dr. Aapo Tanskanen	FMI	Finland
Prof. Dr. Yury Timofeyev	SPB	Russian Federation
Dr. Thomas Wagner	IUP	Germany
Dr. Mark Weber	IUP	Germany
Prof. Dr. Philipp Weihs	BOKU	Switzerland